

NOTE ON OCCURRENCES OF BOULDERS, POSSIBLY GLACIATED, NEAR LEONORA AND LAVERTON, ABOUT LAT. 28° 30' SOUTH.

*By E. DE C. CLARKE.**

(Read Nov. 11, 1919.)

Superficial deposits of gravel, rubble, sand, loam, and laterite cover large areas in the country surrounding Leonora and Laverton, as they do in other parts of the Western Australian goldfields. These deposits vary in character according to the nature of the underlying rocks in the vicinity, from which they have evidently been derived by weathering. However, during the course of field-work in 1917-18, in the Leonora-Laverton country, I noticed deposits the constituents of which had clearly been transported some distance and which, being possibly significant of climatic conditions very different from those now obtaining in the district, appear to deserve notice.

Smoothed fragments of granite and quartz, varying in size from pebbles to boulders five feet in diameter, closely crowded together in a fine bluish-green clay, form the "country" from the surface to a depth of 44 feet in the Government Well at Mertondale near Leonora. All the boulders and pebbles are well rounded, but many have one side distinctly flattened. Although this boulder bed rests on a denuded surface of foliated quartz porphyry (containing in other places auriferous veins and probably contemporaneous with the main gold-bearing series of greenstones) it does not, as far as I noticed, contain fragments of this underlying rock, nor of the closely adjoining greenstones. Moreover, the granite of the boulders appears to me to be different from that of the nearest granite mass (about three miles to the north). Similar boulders are scattered over the flat between the Government Well and Merton's Reward G.M., and are found at the workings 12 miles and nine miles from Malcolm on the road to Mertondale. A few "colours" are rumoured to have been found at the base of a boulder deposit in another well at Mertondale which was inaccessible to me.

Boulder conglomerate occurs on the banks of Mallee Creek, about 25 miles north of Laverton, on the Laverton-Duketon track. (See Fig. 1.) In this place, however, blue-grey matrix is the prominent feature. boulders—which are of a foliated granitic rock—being rather few and far between. The conglomerate is overlain by 15 or 20 feet of recent sandy loam, the red colour of which is in

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marked contrast to the prevailing blue-grey tint of the underlying rock. However, the absence of distinct bedding planes in both deposits makes it impossible to be certain whether or not there is an unconformity between them. The conglomerate is underlain by a greatly weathered rock, probably greenstone, with steeply inclined shear-planes. Here again then there is marked contrast between the underlying rock and that constituting the boulders of the conglomerate.

Mr. Tucker told me that, in sinking his well about a mile south of Mallee Creek, a bed, 46 feet in thickness, of rounded boulders (one of which, according to my informant, was 9 feet in diameter) embedded in bluish "pug" was passed through before "solid country" was encountered.

Between Tucker's and Cork Tree Well (two miles farther south), and again for about three-quarters of a mile before reaching Twelve-Mile Creek on the track to Laverton, rounded boulders, most of which are granitic, are scattered on the surface, as noticed previously by Mr. C. S. Honman.* The underlying rocks in this part are greenstones.

In the dump of the well on Twelve-Mile Creek, about one mile east of the Laverton-Duketon track, are rounded boulders of granite, greenstone, and porphyry, which show the characteristic flattening of one side. The well being full to the brim of rain water at the time of my visit, no further investigation was possible. The country surrounding the well is composed of fine-grained greenstone.

A few rounded boulders of granite were noticed about $1\frac{1}{2}$ miles west of Twelve-Mile Creek on an abandoned part of the light railway line which supplies the Lancefield G.M. near Laverton with firewood. The underlying country is probably greenstone.

Rounded granite boulders occur also along the Morgans-Mt. Margaret telegraph line, but, as the same type of rock crops out near by, this occurrence is not significant.

A few very smooth, rounded quartz pebbles were found among the ordinary quartz and ironstone rubble in the country west of McNie's homestead north of Darlôt, a considerable distance from localities already cited.

It appears, however, that between Mertondale and Malcolm, and between Mallee Creek and Laverton, well-rounded boulders not derived from rocks in the immediate neighbourhood are common.

No agency at present operating in this sub-arid region is competent either to transport these rock fragments from their original situation or to round and smooth them so remarkably, and it therefore seems probable that they are remnants of an extension of the "Wilkinson Range Series" of glacial beds, possibly of late Mesozoic

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or early Tertiary Age, which has been found about 150 miles farther east.*

I did not find on these boulders any undoubted scratches such as occur on the Wilkinson Range specimens, but it is noticeable that some show facetting rather than simple rounding, and that, on the flattened side, which many boulders show clearly, quartz and felspar crystals have, despite their unequal hardness, been equally worn down to form a plane surface.

The rock comprising the uppermost part of a small isolated peaked hill about four miles south of the Ida H. gold mine, near Laverton, is described by Mr. R. A. Farquharson† as an extremely fine-grained clay consisting of mica scales and quartz grains. He adds that the rock shows no signs of stratification but was probably produced by the sorting action of water. The country on which this hill stands is composed of epidiorites and porphyrites, belonging to the main (gold-bearing) series of greenstones. The fine-grained material is probably, therefore, a peculiar type of superficial deposit which, granted the glacial origin of the boulder deposits described above, may be a till belonging to the same series.

NOTE ON MR E. DE C. CLARKE'S PAPER.

Some recent additional geological information bearing upon the matter of the occurrence of boulder beds in the central portion of Western Australia has been made a month or two ago by Mr. H. W. B. Talbot in the country between Zanthus on the Transcontinental Railway and Laverton.

A series of horizontal sediments, arranged in terraces, were found along the banks of the upper reaches of the Ponton River; these sediments were associated with rounded pebbles and boulders of quartz.

Ten miles north-east of Mount Dennis was a horizontal conglomerate thickly studded with quartz boulders and pebbles resting on an uneven surface of granite. A series of arkoses and grits were found to overlie the conglomerate in conformable sequence. These beds were lithologically identifiable with those in the Wilkinson Range near S. lat. 26deg. The Wilkinson Range beds consist of compacted sandstones and claystones, about 100 feet thick, underlaid by a boulder bed. The boulders are of all sizes and generally agree in shape, with one conspicuous flattened side, occasionally covered by such scratchings and markings as result from ice action. Large boulders weighing 2 cwt. and more are by no means uncommon. The Wilkinson Range beds have been traced for a distance of about 200 miles.

* H. W. B. Talbot and E. de C. Clarke, G.S.W.A. Bulletin 75, p. 105, and Journ., Royal Society, Western Australia, Vol. III., p. 80.

† Petrologist, Geological Survey of Western Australia.

The Wilkinson Range beds have as yet yielded no fossils, so that their position in the geological time scale cannot be definitely fixed at present.

These observations in the three widely separated localities are of considerable geological importance, as showing the great extension of this formation in a southerly direction, and its relation to the beds which make up that extensive plateau known as the Nullabor Plain.

It is, on structural and other grounds, highly probable that the beds referred to by Mr. Clarke in his paper, and those met with by Mr. Talbot, form the western extension of the boulder beds met with in the bore at the 337-mile 61-chains peg on the Transcontinental Railway Line at a depth of 1,372 feet below the surface, or about 800 feet below sea level.

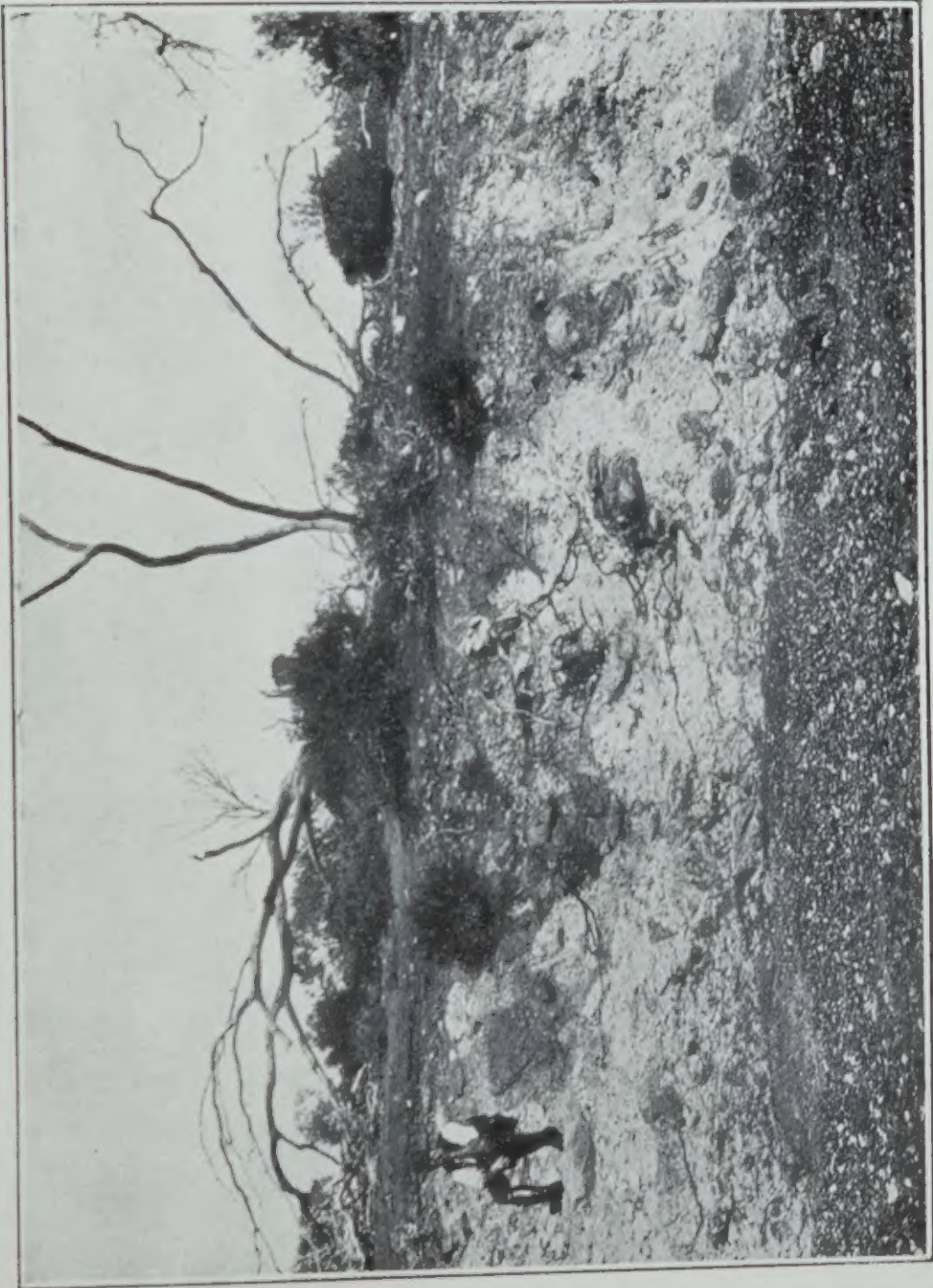
The rocks beneath the Eucla limestone of Tertiary Age, met with in the bore, have yielded two of the most characteristic fossils found in the lower cretaceous strata of South Australia and Queensland, viz., *Aucella hughendensis*, Eth. fms.; *Maccoyella corbiensis*, Moore, together with portions of a bivalve shell, possibly *Fissulunula*, which is also found in the Lower Cretaceous beds of Eastern Australia. There seems to be little doubt, therefore, that the strata pierced in the bore in question are the equivalents of the Rolling Downs beds of Queensland, and that the beds were deposited in that sea, which during this period divided the continent into two portions, viz., the Eastern, or what may be called Asiatic Australia, and the Western Australian Australia.

The occurrence of glacial deposits in Australia, during the Cretaceous period, was first suggested by Sir (then Mr.) Douglas Mawson in 1907, in a paper read before the Australian Association for the Advancement of Science, hence the importance of the recent observations by Messrs. Clarke and Talbot.

It is, however, noteworthy that the Permo-Carboniferous glacial deposits of Western Australia occur in about similar latitudes.

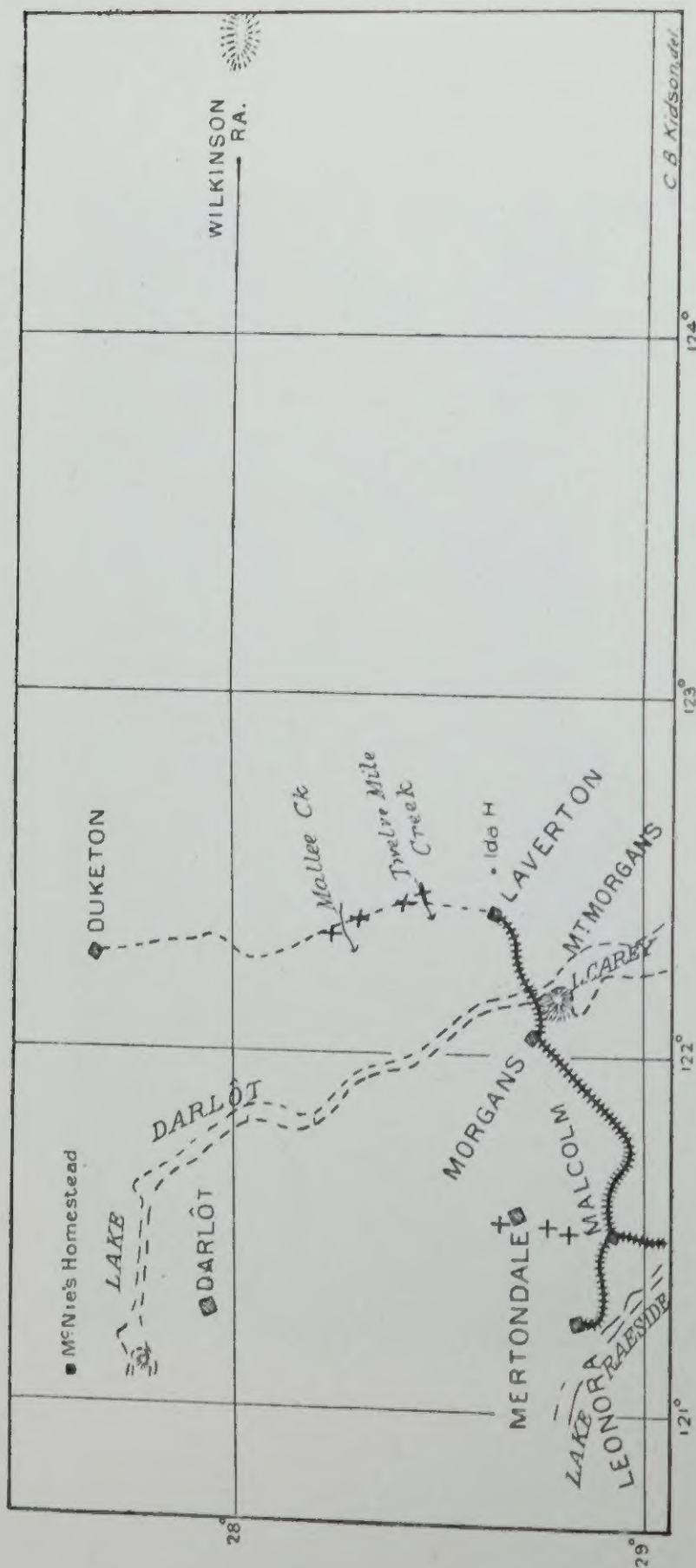
A. GIBB MAITLAND.

Plate VIII.



Boulder Bed in Mallee Creek, 25 miles north of Laverton.

Plate IX.



SKETCH MAP
SHOWING POSITION OF
BOULDER DEPOSITS

Scale
0 25 50

Approximate position of deposits shown thus +